Coleoptera associated with pig carcass exposed in a forest reserve, Manaus, Amazonas, Brazil

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MISE, K.M., SOUZA, A.S.B., CAMPOS, C.M., KEPPLER, R.L.F. & ALMEIDA, L.M. **Coleoptera associated with pig carcass exposed in a forest reserve, Manaus, Amazonas, Brazil.** Biota Neotrop. 10(1): http://www.biotaneotropica.org.br/v10n1/en/abstract?inventory+bn03110012010.

Abstract: The Coleoptera fauna of forensic importance associated with *Sus scrofa* Linnaeus, 1758 carcass decomposition in Ducke Reserve, Manaus, Brazil, was determined. A total of 41 species, belonging to six families and 11 subfamilies were collected. Staphylinidae presented the higher richness with 17 species sampled, followed by Histeridae, with 11 and Scarabaeidae with nine species. *Euspilotus azureus* (Sahlberg, 1823) (Histeridae), *Aleochara* sp. (Staphylinidae) and *Oxelytrum cayennense* (Stürm, 1826) (Silphidae) occurred in all stages of decomposition. *Omalodes lucidus* Erichson, 1824 and *Scapomegas auritus* Marseul, 1855 (Histeridae) are recorded for the first time in the Amazon, being also reported for the first time associated with a decomposing carcass. The fauna differs from those of other Brazilian regions, emphasizing the importance of studies to determine the regional insect fauna of forensic importance that can be used in criminal investigations.
Keywords: *beetles, forensic entomology, new records, diversity, Amazon Rain Forest.*

MISE, K.M., SOUZA, A.S.B., CAMPOS, C.M., KEPPLER, R.L.F. & ALMEIDA, L.M. **Coleoptera associados a carcaça de porco em reserva florestal, Manaus, Amazonas, Brasil**. Biota Neotrop. 10(1): http://www.biotaneotropica.org.br/v10n1/pt/abstract?inventory+bn03110012010.

Resumo: A fauna de Coleoptera de importância forense foi analisada na Reserva Ducke, Manaus, Brasil, durante a decomposição de carcaça de *Sus scrofa* Linnaeus, 1758. Foram coletadas 41 espécies, pertencentes a seis famílias e 11 subfamílias. Staphylinidae apresentou a maior riqueza com 17 espécies, seguida por Histeridae, com 11 e Scarabaeidae com nove espécies. *Euspilotus azureus* (Sahlberg, 1823) (Histeridae), *Aleochara* sp. (Staphylinidae) e *Oxelytrum cayennense* (Stürm, 1826) (Silphidae) ocorreram em todos os estágios de decomposição. *Omalodes lucidus* Erichson, 1824 e *Scapomegas auritus* Marseul, 1855 (Histeridae) são registrados pela primeira vez na Amazônia, sendo também a primeira amostragem na qual essas espécies são encontradas em carcaça em decomposição. A fauna difere das de outras regiões do Brasil, ressaltando a importância de estudos regionais para posterior utilização como provas forenses.
Palavras-chave: *entomologia forense, novas ocorrências, diversidade, Floresta Amazônica.*

Introduction

Cadavers can be colonized by different animal species, among which insects have a major role. The study of the entomological succession, as well as the time they spend on carcass is used to determine the circumstances of death and to estimate the post-mortem interval (Catts & Goff 1992).

The order Coleoptera is the richest and most diverse among insects (Arnett Jr. & Thomas 2000). Such diversity is encountered on carcasses as well. In Brazil, Luederwaldt (1911), found about 62 species associated with carcasses, while Mise et al. (2007) found 112 species, belonging to 26 families, with 12 of them considered to be of forensic importance. Some authors aimed on specific families contributing with taxonomic or survey studies of necrophilous beetles. On Scarabaeinae fauna of legal medicine interest, 113 species of 26 genera were found on southeast region of Brazil especially on São Paulo State (Pessôa & Lane 1941). Other papers reported only a few species of Coleoptera, as their methodologies were not focused on this fauna (Carvalho et al. 2000, 2004, Cruz & Vasconcelos 2006).

Because of the specificity and scarcity of necrophilous coleopterofauna studies it is fundamental to sample the species of different regions. Pujol-Luz et al. (2008) emphasized the importance of creating identification keys and better knowing the distribution of carrion species in Brazil. The only paper addressing Amazonian fauna was made by Ururahy-Rodrigues et al. (2008) who recorded the taphonomy effects of *Coprophanaeus lancifer* (Linnaeus, 1767) (Scarabaeidae) in pig carcass. The present paper sought to survey the Coleoptera species of Amazon region, enabling them to be used as forensic evidence.

Material and Methods

The study took place in Adolpho Ducke Forest Reserve which belongs to the Instituto Nacional de Pesquisas da Amazônia (INPA). It has an area of 100 km^2, and is situated in the vicinity of Manaus (02° 55' 01" S and 59° 53' 59" W) and is still connected to a continuous forest area on the eastern side. The chosen area has a vegetation called "terra firme" forest, which is not seasonally flooded. The meteorological data were obtained from the Instituto Nacional de Meteorologia (INMET, 2008).

The samplings were made from July 9 to July 16, 2008 by exposing a pig carcass (*Sus scrofa* Linnaeus, 1758), weighting 25 kg, mechanically killed by cervical displacement, without using chemical substances that could affect the decomposition process and the attractiveness to insects. The carcass was positioned inside an iron galvanized cage with a wire mesh of 1.5 cm opening, with four pit-fall traps around it, each one with 11 cm of diameter, filled with a solution of water and salt. The manual samplings were done using forceps directly in the carcass from 08:30 to 01:30 AM, and from 03:30 to 07:00 PM, and the traps were observed in the end of the week. The specimens collected were killed in alcohol 70%, mounted and identified using keys (Peck et al. 1998, Gnaspini 1999, Newton et al. 2000, Van Tassell 2000, Navarrete-Heredia et al. 2002, Almeida & Mise 2009). The material was deposited in Coleção de Entomologia Pe. J. S. Moure, Department of Zoology (UFPR) and in Instituto Nacional de Pesquisas da Amazônia (INPA). The stages of decomposition were divided according to Bornemissza (1957).

Results

The decomposition occurred faster than other studies, reaching the last stage of decomposition in only 8 days, probably due to high temperature (average temperature 27.98 ± 0.78 °C), relative humidity (78.29 ± 6.4%) and rainfall (3.37 ± 9.54 mm) (Figure 1). During this period 41 species belonging to five families and 11 subfamilies were collected (Table 1). Staphylinidae had the higher richness with 17 species, followed by Histeridae with 11, Scarabaeidae with nine species; Silphidae and Leiodidae had only one species each. All families and most of the species were captured manually, and only three species were found exclusively on the pit-fall traps. Five species had a nocturnal activity, *Hister* sp. (Histeridae), *Coprophanaeus lancifer* (Linnaeus, 1767) and *Deltochilum peruanum* Paulian, 1938 (Scarabaeidae), *Oxelytrum cayennense* (Stürm, 1826) (Silphidae) and *Aleochara* sp. (Staphylinidae).

In the dry stage of decomposition was found the richest Coleoptera fauna, with 28 species captured, being followed by the putrefaction with 17, the black putrefaction and butyric fermentation with eight and the initial decay with only four species. *Euspilotus azureus* (Sahlberg, 1823) (Histeridae), *Aleochara* sp. and *Oxelytrum cayennense* occurred in all stages of decomposition.

The following species of Histeridae are recorded for the first time not only in Amazonia but also in a decomposed carcass: *Omalodes lucidus* Erichson, 1824 and *Scapomegas auritus* Marseul, 1855.

Discussion

The decomposition of pig carcasses weighting 10 kg (Carvalho & Linhares 2001), 3.64 kg (Iannacone 2003) and 17.7 kg (Wolff et al. 2001) lasted, respectively, 20 days in Campinas, southeastern of Brazil, 84 days, in Callao, Peru and seven months, in Medelllín, Colombia while in the present experiment, it lasted only eight days, probably because of the higher temperature. The sampling was possible even during rainfall, which occurred in the first day of putrefaction, as some species hide beneath the carcasses. This stage of decomposition attracts a large number of predator beetles as there is a high number of Diptera larvae, explaining the high richness.

The number of families associated with carcasses agree with other studies (Souza & Linhares 1997, Centeno et al. 2002, Souza et al. 2008), although there are reports of eight (Wolff et al. 2001) and 13 (Mise et al. 2007) families. This variance is probably due to differences in sampling method and abiotic conditions.

Staphylinidae was also the family with the highest species richness in Souza & Linhares (1997), Wolff et al. (2001) and Mise et al. (2007), with six, seven and 29 species, respectively. In the Amazon region, this is the first study done specifically for surveying necrophilous beetles. Since most of the species were captured

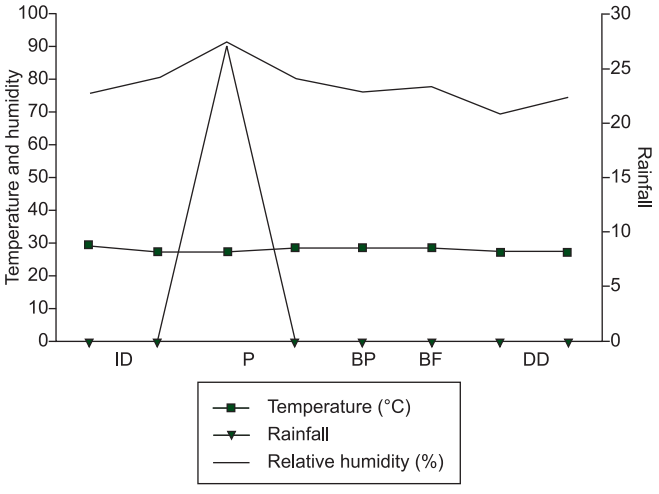

Figure 1. Mean temperature, relative humidity and rainfall during the sampling period (days). ID: Initial decay; P: Putrefaction; BP: Black putrefaction; BF: Butyric Fermentantion; DD: Dry decomposition.

Table 1. Collected Coleoptera species with their respective sampling method, period of day, and stage of decomposition. Adolpho Ducke Forest Reserve, Amazonas, Brazil, July 2008.

Family/Subfamily/Species	Collecting Method		Period		Stage of Decomposition				
	Manual	Pit-fall	Diurnal	Nocturnal	ID	P	BP	BF	DD
					July 9-10	July 11-12	July 13	July 14	July 15-16
HISTERIDAE/Saprininae									
Euspilotus azureus (Sahlberg, 1823)	X	X	X	-	X	X	X	X	X
Euspilotus sp.	X	-	X	-	-	X	-	-	-
HISTERIDAE/Histerinae									
Hister sp.	X	-	X	X	-	X	X	-	X
Omalodes bifoveolatus Marseul, 1853	X	-	X	-	-	X	X	-	X
Omalodes foveola Erichson, 1834	X	-	X	-	-	X	-	-	-
Omalodes lucidus Erichson, 1834	-	X	X	-	-	-	-	-	
Phelister sanguinipennis Marseul, 1853	X	-	-	-	-	-	X	-	-
Phelister sp.1	X	-	-	-	-	-	-	-	X
Phelister sp.2	X	-	-	-	-	-	-	-	X
Phelister sp.3	X	-	-	-	X	-	-	X	-
Scapomegas auritus Marseul, 1855	X	-	X	-	-	-	-	-	X
HYDROPHILIDAE/Sphaeridiinae									
Megasternini sp.	X	-	X	-	-	-	-	X	X
Hydrophilidae sp.	X	X	X	-	-	X	-	-	-
LEIODIDAE/Cholevinae									
Dissochaetus amazonicus Gnaspini, 1999	X	-	X	-	-	X	-	-	X
SCARABAEIDAE/Scarabaeinae									
Canthidium aff. depresum	-	X	-	-	-	-	-	-	-
Canthon aff. sordidus	X	-	X	-	-	X	-	-	X
Canthon triangularis (Drury, 1770)	X	-	X	-	-	-	-	-	X
Coprophanaeus lancifer (Linnaeus, 1767)	X	-	X	X	-	-	X	-	X
Deltochilum aff. guyanense	X	X	X	-	-	X	-	-	-
Deltochilum peruanum Paulian, 1938	X	-	-	X	-	X	-	-	-
Deltochilum icarus (Olivier, 1789)	X	-	X	-	-	-	-	-	X
Dichotomius boreus (Olivier, 1789)	-	X	-	-	-	-	-	-	-
Eurysternus hypocrita Balthasar, 1939	X	-	X	-	-	X	X	X	-
SILPHIDAE/Silphinae									
Oxelytrum cayennense (Stürm, 1826)	X	X	X	X	X	X	X	X	X
STAPHYLINIDAE/Aleocharinae									
Aleochara sp.	X	X	X	X	X	X	X	X	X
Hoplandria sp.	X	X	-	-	-	X	-	X	-
Aleocharinae sp.	X	-	X	-	-	-	-	-	X
STAPHYLINIDAE/Osoriinae									
Osorius sp.	X	X	X	-	-	-	-	-	X
STAPHYLINIDAE/Oxytelinae									
Anotylus sp.	X	-	X	-	-	-	-	-	X
STAPHYLINIDAE/Paederinae									
Lithocharis sp.	X	-	X	-	-	-	-	-	X
Stilocharis sp.	X	-	X	-	-	-	-	-	X
STAPHYLINIDAE/Staphylininae									
Neobisnius sp.	X	-	X	-	-	-	-	-	X
Neohypnus sp.	X	-	X	-	-	X	-	-	X
Oligotergus sp.1	X	X	X	-	-	-	-	-	X
Oligotergus sp.2	-	X	-	-	-	-	-	-	-
Phylonthus sp.	X	-	X	-	-	X	-	X	X
Platydracus ochropygus (Nordman, 1837)	X	-	X	-	-	-	-	-	X
Platydracus sp.	X	X	X	-	-	-	-	-	X
Plociopterus sp.	X	-	X	-	-	-	-	-	X
Xanthopygus bicolor Laporte, 1835	X	X	X	-	-	X	-	-	X
Xanthopygus sp.	X	X	X	-	-	-	-	-	X

ID: Initial Decay; P: Putrefaction; BP: Black Putrefaction; BF: Butyric Fermentation; DD: Dry Decomposition.

manually, the importance of active sampling to achieve an accurate determination of insect succession is emphasized.

It is known that seasonal and climatic differences alter the arrival of carrion insects (Archer 2003). Despite the differences in the entomological succession, there is a relative constancy of the fauna composition at the genus level in Brazil. Mise et al. (2007) obtained species of *Euspilotus*, *Aleochara* and *Oxelytrum* in great numbers. Four species occurred in the first stage of decomposition, disagreeing with Souza & Linhares (1997), which indicated that Coleoptera fauna occurred only after the second stage. Although all species which occurred in all stages of decomposition are predators, they are there for different reasons. *Aleochara* sp. and *O. cayennense* breed and oviposite on carcasses, the first because its larvae are pupal parasitoids of higher Diptera, while in the latter, the larvae are necrophagous. *Euspilotus azureus* are generalist predators, feeding on larvae of different stages of decomposition.

Just a few species were found during night time, since manual sampling effectiveness is considerably affected by the absence of light, and the use of flashlights would attract insects not associated with carcasses. Furthermore, species of *Aleochara*, who are known to be active predators of larvae and eggs of cyclorrhaphous Diptera (Klimaszewski 1984), had different behavior during the night. During daytime they roam around predating larvae below the carcass, while at night they are less active, staying over the carcass predating eggs of Diptera.

The three species of the genus *Omalodes* and *Scapomegas auritus* are usually collected during the decomposition of fruits (Dégallier & Gomy 1983) and in rotting plants, where they feed on dipterans larvae and eggs (Kovarick & Caterino 2000), but in this study they were sampled in a decomposing carcass.

The great number of species encountered is different from those of other regions, emphasizing the importance of studies focusing regional fauna before using them as forensic evidence. Although this paper brought a great contribution to the knowledge of Amazonian carrion fauna, it is important to study the effects of the rainy season over this fauna.

Acknowledgements

This is the number 1797 contribution of Department of Zoology, UFPR. The authors are thankful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq, process number 131472/2007-0 (ASBS), 306772/2006-0 (LMA) and to CAPES (PROCAD Program) 018/2006 for the opportunity of interchange between universities. Also to Carla L. Bicho, Gerardo Arriagada, Nicolas Dégallier, Fernando Z. Vaz-de-Mello, Paschoal C. Grossi, Angelico Asenjo F., Fernando W. Leivas, Daniel P. Moura, for the aid in the identification and Aldenira O. Silva, for support in the field.

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Received 29/09/09
Revised 11/03/10
Accepted 26/03/10